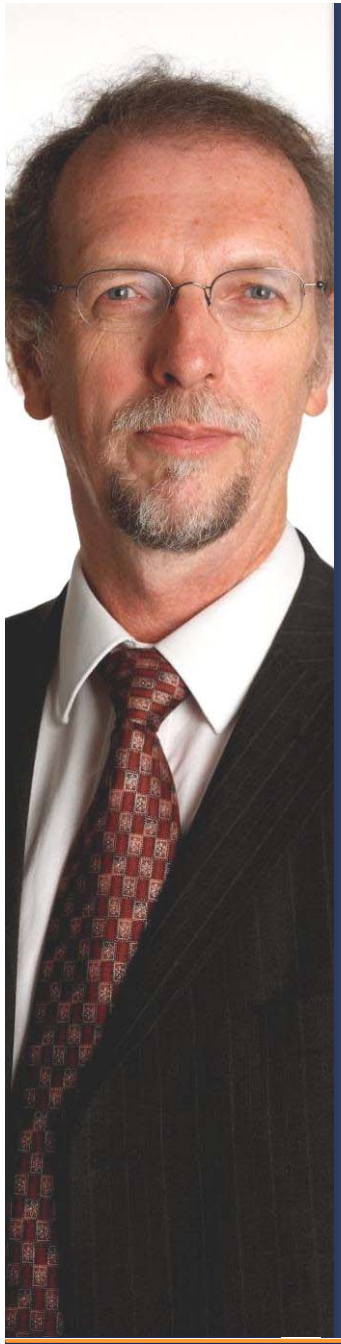

No Man's Land:
Where Academia Meets Industry

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Agenda

Investigating the Roles of Academic Research in relation to Business Need ...

- An Unfortunate Image
- What is Business
- The Nature of Product
- The Capability-Pool
- Technology and Science
- Along the Time-Line
- Research
- The Grand Challenge ...
  ... Pulling Together for Common Interests

Irresistible Force ..&.. Immovable Object

- "Academia doesn't do anything relevant to my needs!"

Industry

- "Industry doesn't make use of the gems I have on offer!"

Academia

Tank in badly shelled mud area. Battle of Paschendaele. November, 1917.

Business Basics

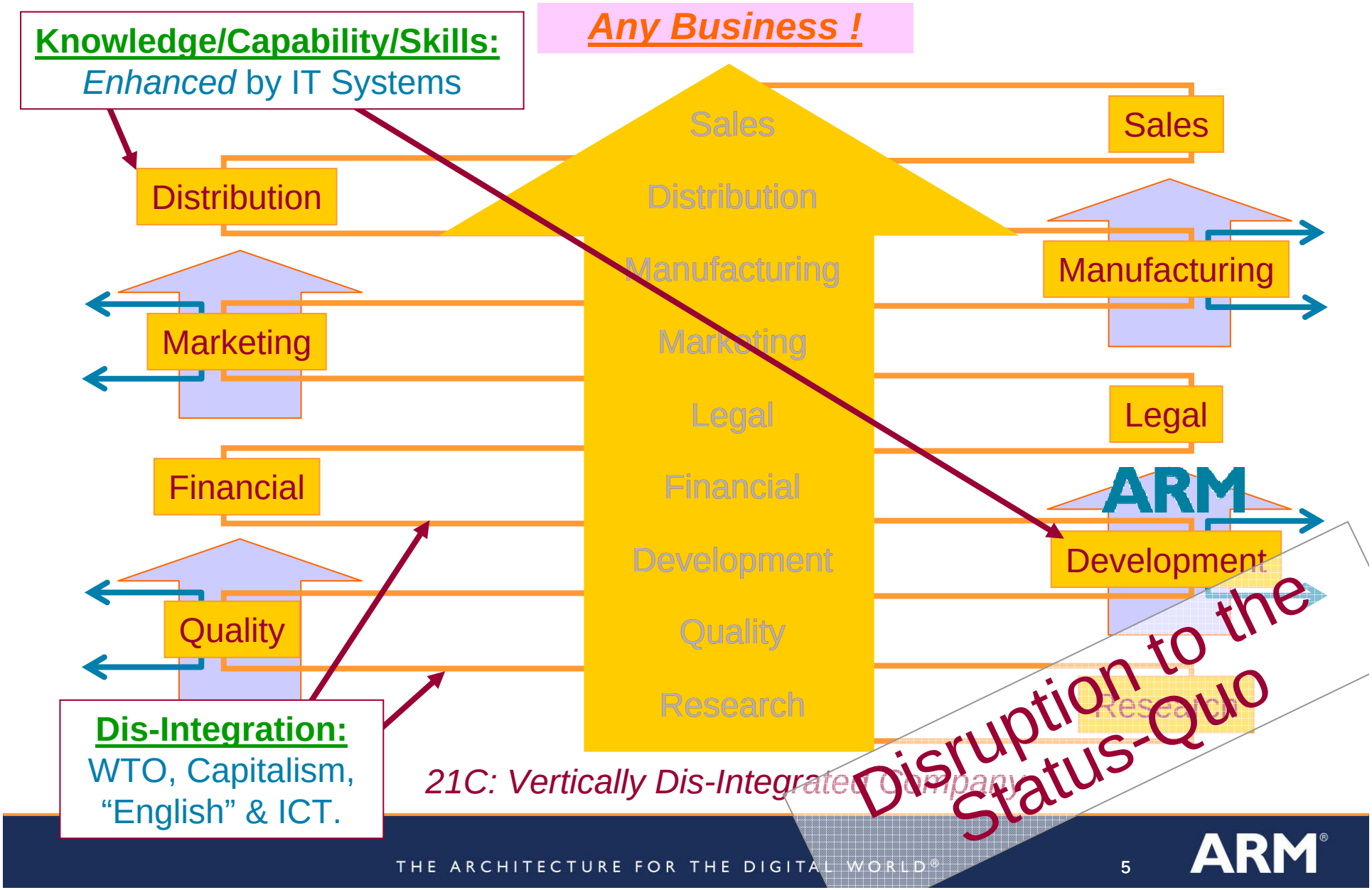
- Good Businesses are Money Making Machines
  - They are not Charities; and don't understand Altruism
    - *Illegal for Directors to spend money on Non-Business things*
    - *Try to make money out of what is already known! (aka Innovation)*

- Businesses need Product Differentiation to maintain value
  - End-Customers buy Products, not Technology
    - *Technologies enable Products ... but are not valuable in themselves!*
    - *It is the Business-Models that makes the money*

- Good Businesses don't take unnecessary risks
  - They just want to establish market leading Products
    - *Design increases Cost ... but not always Value.*
    - *They need Design/Dev't, but don't want it*
      ... So they strive to minimise it!

... Too busy 'Doing'; No time for 'Research' !?

Increased Globalisation ...



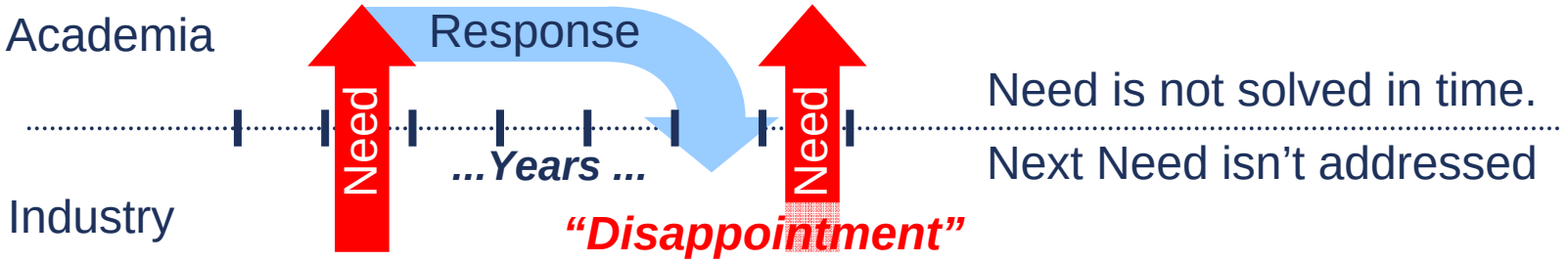
Business & Economy

- UK is 1% of the world population and 5% of its Economy
  - Europe, the USA and Japan ...
    - *0.75B people12% of world population*
      ... 60% of its Economy
    - *2B of the 'other '5.4B people are catching up **FAST**!*

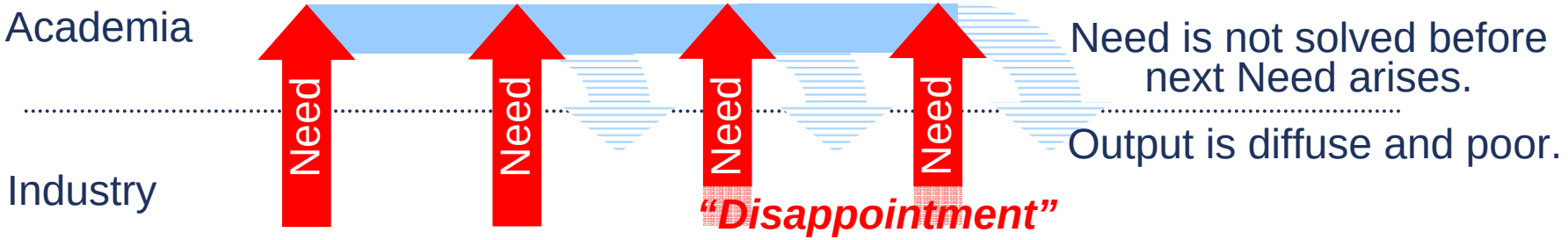
- To stay ahead ... to keep our individual and collective jobs
  - Do 10% more pa, for the same pay ... forever!
  - Work Smarter **and** Faster !
  - Innovate in your Product and your Business Process
  - Optimise your Product (Get rid of all ***non-essential*** activities!)
  - Deliver your Product effectively

Though Business makes these observations ...
... They equally apply to Academia and Governments!

Reacting to Businesses Problems



- Academia cannot respond fast enough to 'current' Need

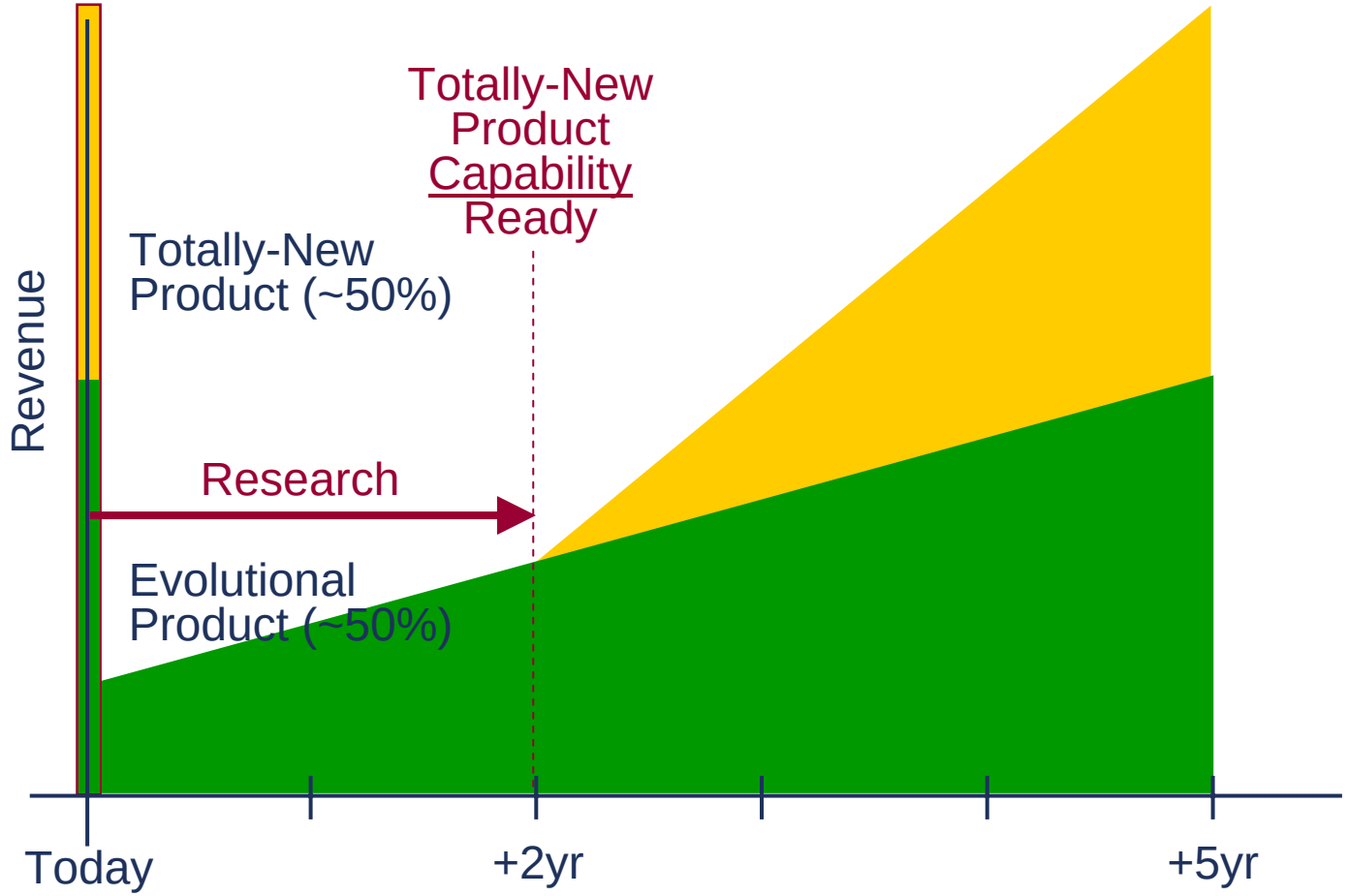


- Industry changes its Needs as issues arise

... Time is an important factor: Academia must prepare things <u>ahead</u> of Industry identifying the Need !

Research ... The Business View

- It is typical that a Hi-Tec businesses[1] knew nothing about the product that constitutes 50% of their current revenue, 5yr earlier.



... Capabilities that take longer than 2yr to Establish ***have to be Acquired***

1: Similar to ARM

The Whole Product - The Car

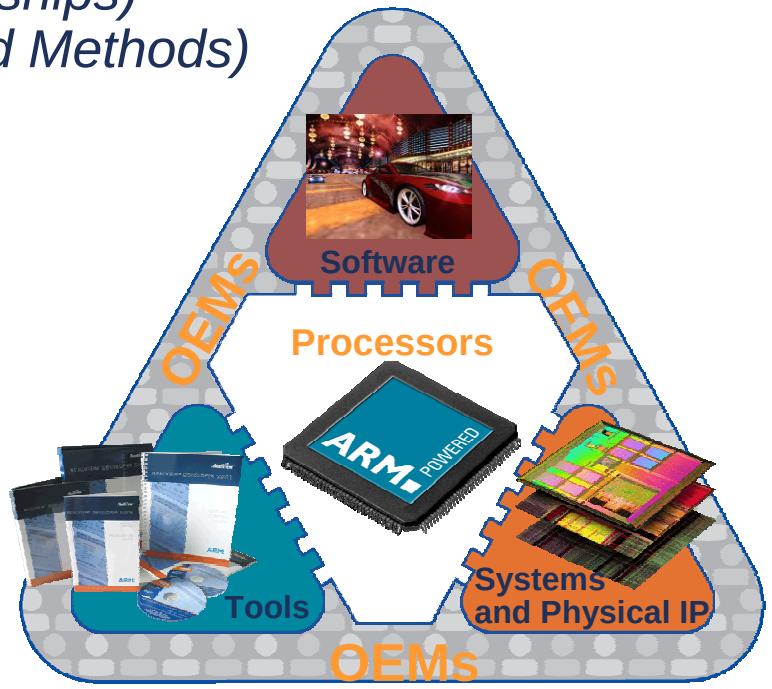
- **Technology ...**
  - *Aesthetics, Performance* *(Obvious)*
  - *Internal Combustion Engine*
  - *Bearings, Casting, Metal forming, Painting*
  - *Aerodynamics, Suspension, Electronics*
  - *etc*
- **Infrastructure ...**
  - *Manufacture and Distribution*
  - *Road network, Fuel supply, Tyres*
  - *Service network & Training*
  - *Sales and Marketing*
  - *etc*
- **Business Model ...**
  - *Brand & Image*
  - *Finance schemes, Service deals*
  - *Warranty*
  - *etc*

The Whole Product - Mobile Phone

- **Technology ...**
  - *SOC and Software (Obvious)*
  - *Battery, Plastic, LCD, RF, Conformance ...*
  - *etc*
- **Infrastructure ...**
  - *Manufacture and Distribution*
  - *Cell Infrastructure*
  - *Connections to wired network*
  - *Services*
  - *Sales and Marketing*
  - *Roaming (Standards and Agreements)*
  - *etc*
- **Business Model ...**
  - *Brand & Image*
  - *Paying for the phone. Paying for the network*
  - *Collecting money*
  - *etc*

The Whole Product - ARM CPU-IP

- **Technology ...**
  - *CPU Architecture (Obvious)*
  - *Compilers, Debuggers, Busses, Peripherals, Drivers, Stacks*
  - *etc*
- **Infrastructure ...**
  - *Connectivity with EDA tools (Partnerships)*
  - *Availability from Foundries (Partnerships)*
  - *Deployment models (Standards and Methods)*
  - *Documentation & Training*
  - *Applications support*
  - *Sales and Marketing*
  - *etc*
- **Business Model ...**
  - *Brand & Image*
  - *Paying (Licence and/or Royalty)*
  - *Security (Legal and Business)*
  - *etc*



Knowledge Maketh the Business ...

Though ***world renown*** in their markets, could ...

- **Mercedes** design and make Aeroplanes?
  - Unlikely !
- **Nokia** deliver Hard Disks?
  - Improbable !
- **ARM** be a Fabless Semiconductor Co?
  - Not easy !

NOKIA

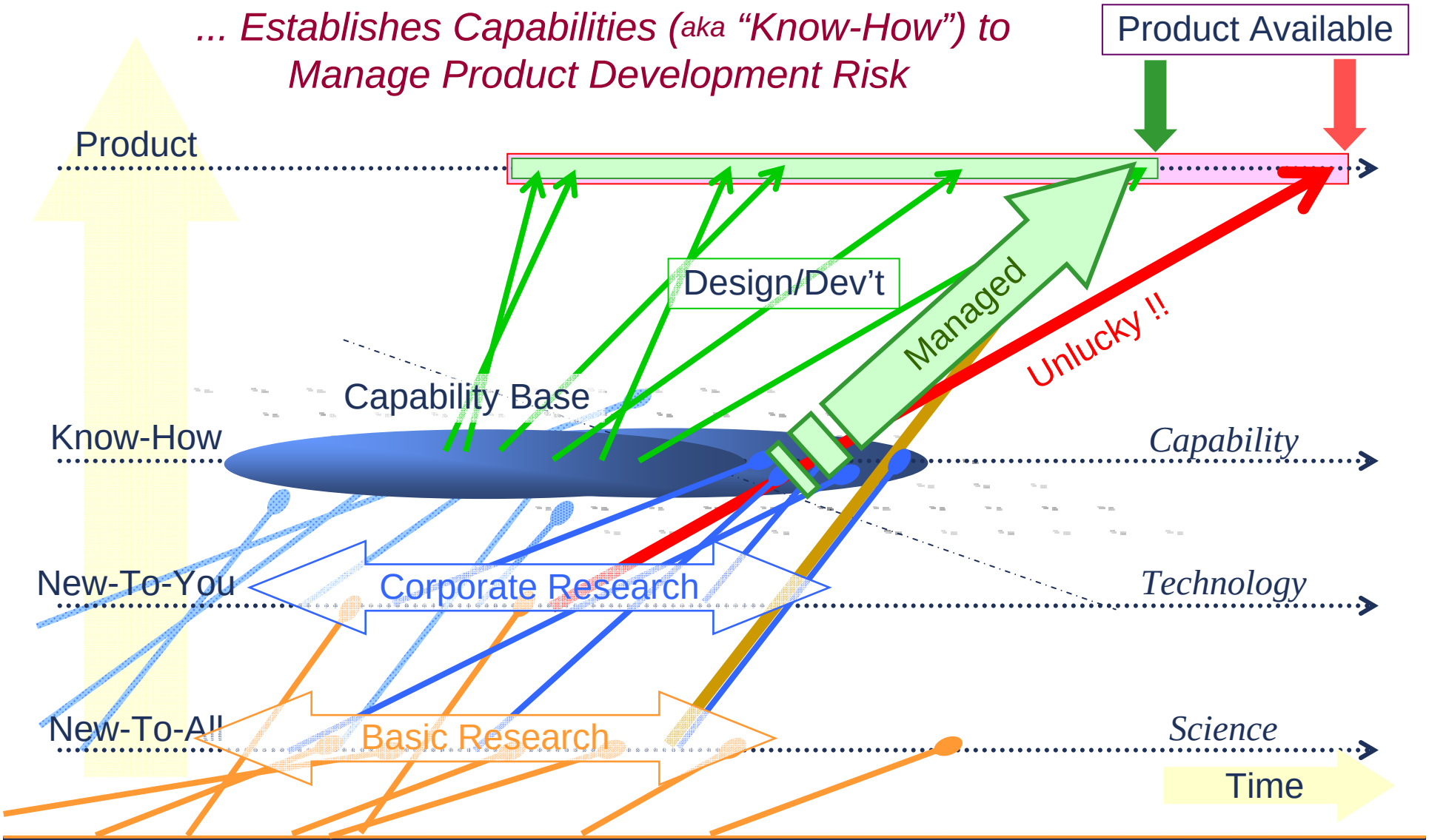
FUJITSU

ARM

csr

... Each businesses Capability Base defines the Products it stands a chance of making successfully.

Research ... The Capability View



With Ref to Jay Barney : Firm resources and sustained competitive advantage. 1991

Understanding; the Basis of Relationship

- ***Capability:*** Installed Technology in our specific Business
  - What Know-How a Business needs to develop its Product
- ***Technology** (New to You):* The Appliance of Science[1]
  - Regularised Science ... Ready for predictable use in Businesses.
  - Others may already have it as Capability
- ***Science** (New to Everybody):* Tamed 'Fundamentals'
  - Understood, Repeatable, Predictable ... but not yet Regularised
- It may take many years to move *Science* to *Capability*
  - In ~2yr Horizons Companies need to establish Capabilities.
  - Universities predominantly produce Science
  - Spin-off's created to establish Technology
    - *Which Bigger-Businesses can then incorporate*

1: With thanks to Zanussi

Science & Technology in Business

The Opportunities that Technology and Science present to Business are very different:

- ***Technology*** is (usually) applicable to a Range of Businesses
  - *So Existing Business **can** assess the possibilities/value of a Technology within the context of its role.*
    - *Investors hold a business to its role!*
  - *See as examples:*
    - *Electronics, Computers, IT*
    - *Iron, Concrete, Ceramics, Plastic, Wood*
- ***Science*** is not (seldom) aligned to Existing Business
  - *So Existing Business **cannot** assess the possibilities/value of a Science within the context of its role.*
  - *See as examples:*
    - *Carbon Nanotubes, Quarks, Neurons, Quantum Mechanics*
    - *Lasers (in the 80's), Fluid Dynamics (in the 40's), Calculus*

... Business Needs are (always) for Technology not Science

The Common Vision

The Common Vision keeps all Research (Corporate and Academic) in line with current and future needs judged beneficial to the (UK) Economic Exploitation.

- **Priorities for Technology**... see TSB and FP7
- **Objectives for Science**... see Grand Challenges

- Everybody and Anybody (You and Me) should contribute ...
  - *You may be a Researcher in one part of your life ...*
    ... but you are an equal-status Consumer in the other!
- Business input is valuable but not uniquely so
  - *Business **is** the engine of the Wold's Economy ...*
  - *But Best for Business is **not necessarily**, best for the UK Economy*
- Winners have to be picked ...
  - *Some Visions are more attainable than others*
  - *Some Visions offer greater Economic opportunity*
  - *And there has to be losers!*

Priorities for Technology

*Technology Priorities, provide a **specific** guide for Near-Term Research activities (see FP7 and TSB Priorities)*

- Technology is exploitable Science...
  - A means to an end; not an end in itself
  - Is applicable across a range of Products
  - ***Identifiable Business Interests***
  - It has a value within a Product but is not inherently valuable.
    - *EPSRC and University Licensing Dept's please note!*
  - A viable National Economic Strategy encourages their development
    - *Must be Globally Pre-Eminent*
    - *Must not be 'me-too' Technologies*
    - *Must be Technologies where we have a National Lead or Predisposition*

... Skill-Centres for Technologies are the precursors of Locally Significant Business Development

Objectives for Scientific

*Scientific Objectives provide a **general** guiding for Longer-Term Research activities (see Grand Challenges)*

- Science...
  - Fundamental knowledge
  - Unquantifiable business opportunity
  - ***Limited Business Interests***
  - >90% of it will be unexploitable at any given time.
    - *>10% will make it to Technology*
    - *EPSRC and University Licensing Dept's please note!*
  - A viable National Economic Strategy encourages their development
    - *Must be Globally Pre-Eminent*
    - *Must not be 'me-too' Science*
    - *Must be Science where we have a National Lead or Predisposition*

... Skill-Centres for Science are the precursors of Nationally Significant Economic Development

Scientific Objective ... The Grand Challenge

"I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth ..."

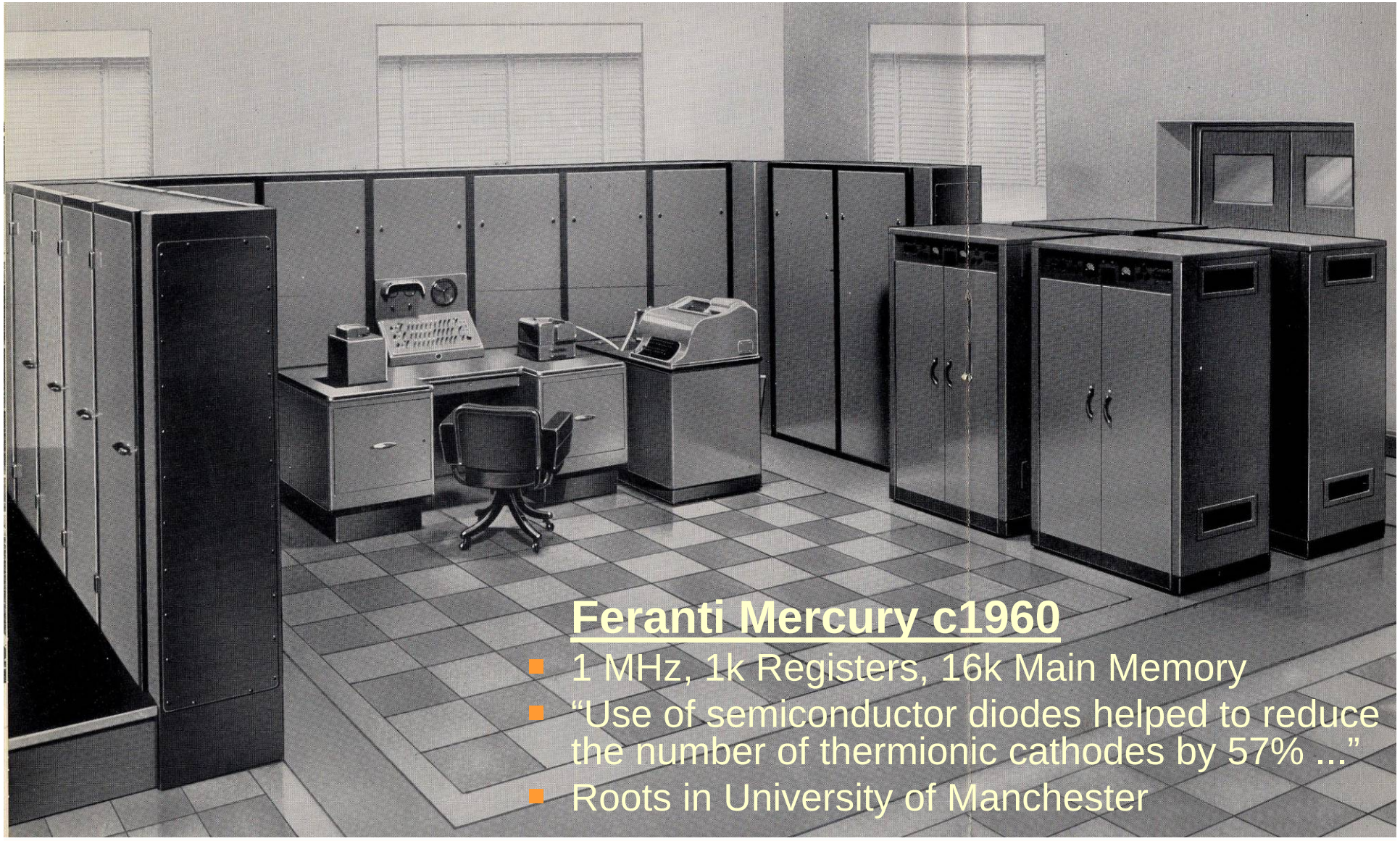
- The Man on the Moon Address
- President John F. Kennedy
  May 25, 1961
- A Special Address to Congress
  On The Importance of Space

He wasn't thinking about the Integrated Circuit Business, or the Deeply Embedded Intelligent Products built around them. Nor the Equipment and EDA businesses ...

... In 1961 "He had a dream".

(or was that someone else!)

Computing in 1960-65

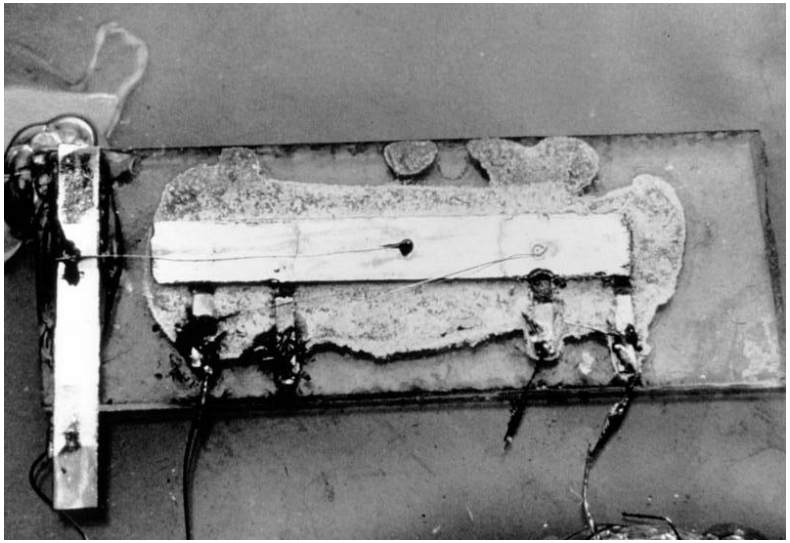


Feranti Mercury c1960

- 1 MHz, 1k Registers, 16k Main Memory
- “Use of semiconductor diodes helped to reduce the number of thermionic cathodes by 57% ...”
- Roots in University of Manchester

Computing History

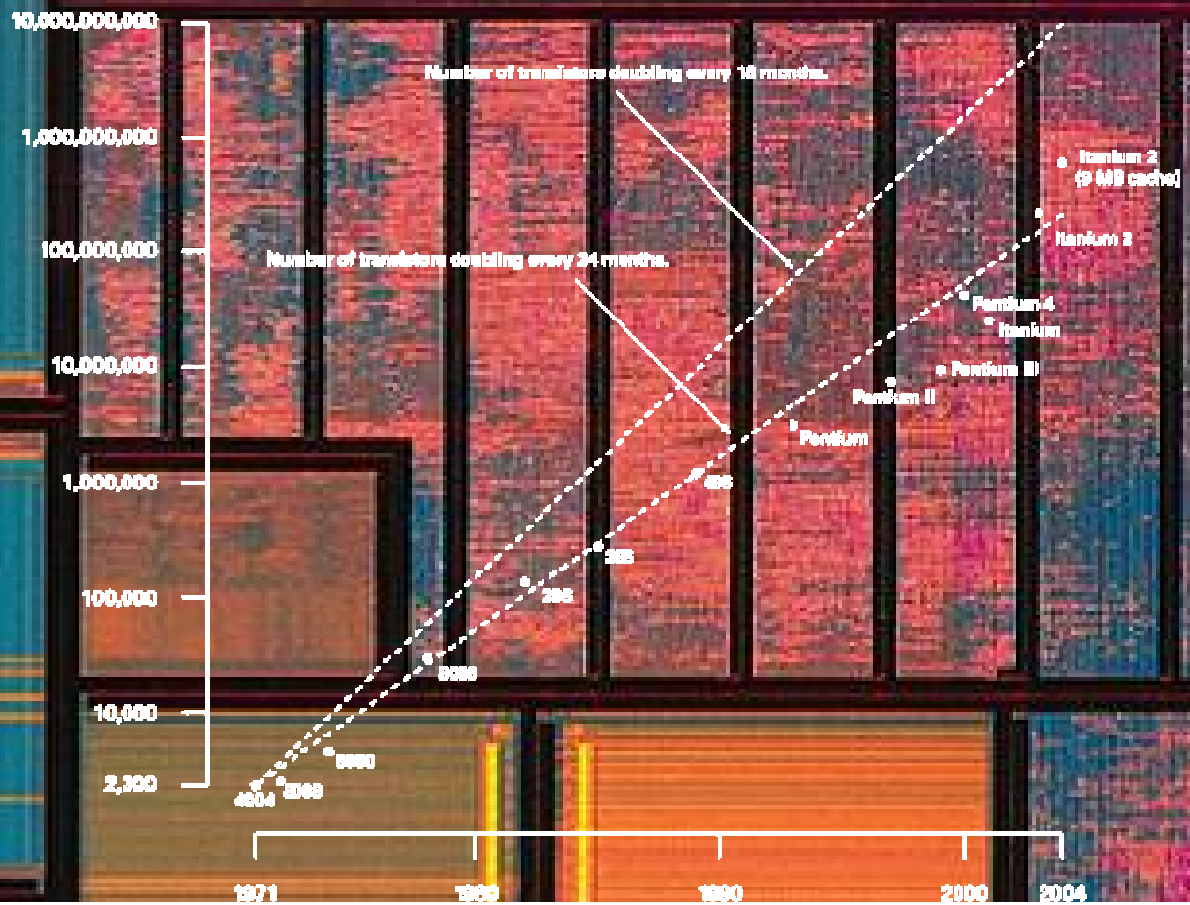
- 1947: Transistor
  - Bell Laboratories
  - Shockley, Bardeen and Brattain



- 1958: Integrated Circuit
  - Texas Instruments
  - Jack Kilby

The $300B pa Semiconductor Industry

- Roots in “that” 1961 Grand Challenge!
- Despite no specific line-item for Semiconductors!
- ***And*** America got a man on the Moon!



Atmel Diopsis Picture from Wikipedia

The Grand Challenge

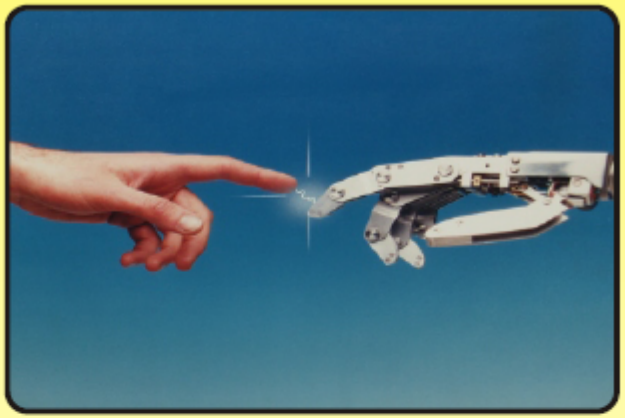
- Publicly Appealing and Scientifically Challenging themes with a possibility of being Achieved in 10+yr. With the possibility of interesting spin-off Science, with Technology potential
  - The unknowns ...
    - *The Emerging Science*
    - *The Commercial Opportunities*
    - *The Benefit to the UK Economy*
    - *Exploitation Potential within the UK or ROW*
  - The Benefits ...
    - *Strong Public Support (Due to the Public Appeal of the Challenges)*
    - *Strong Financial Support for Research (due to the Public Support)*
    - *Aligned Research activities and more Research Partnerships*
    - *Easier Marketing*
    - *Easier Involvement from Business*

Not a list of specific tasks ...

... A Common Vision; A Rallying Cause; A Vector

UK's "Microelectronic" Grand Challenges

Design Vision



Grand Challenges

in

Microelectronic Design

a report from the initiative:

Research Council

Grand Challenges for Silicon Technology

1. **Vision for UK Silicon Nanoelectronics Research:** We believe that a creative and intelligent use of silicon will benefit our society in the areas of health, wealth creation, education, well-being and the environment.
2. The EPSRC Delivery Plan for the 2007 HM Government Comprehensive Spending Review includes: nanoscience to nanoengineering; towards next generation healthcare; energy; digital economy; towards better exploitation; essential platform to the knowledge economy; securing the future.
3. Silicon Futures is a network of UK universities undertaking research in silicon technology. The founding members are the universities of Birmingham, Cambridge (Engineering and Physics), Edinburgh, Glasgow, Imperial College, Liverpool, UMIST, Newcastle, Queen's Belfast, Sheffield, Southampton, Surrey and Warwick
4. A key objective identified at an early stage in the life of the network was to develop flagship projects which made use of the strengths of the community whilst at the same time were of major strategic value to the UK economy. The network was also encouraged by EPSRC to identify specific areas where future research might focus. The Grand Challenges set out to meet these objectives in alignment with the EPSRC Delivery Plan.
5. For the UK to play a world leading role in silicon based nanoelectronics research it must focus on unique capabilities and key strengths. These include materials, metrology, modelling and the integration of silicon with other technologies. It is not realistic to develop mainstream CMOS technology miniaturization (more Moore) in competition with the likes of Intel, ST Microelectronics or research centres such as IMEC, where high volumes of chips are produced. Instead, strategic partnerships with such organisations will be sought where this is appropriate and necessary.
6. The first 4 grand challenges (G1-G4) are specific technical areas of strength in the UK, while the last 3 (G5-G7) are flagship projects aligned to the CSR.

Q: Do they attract the Public Interest and inspire the Researchers through their Scientific vision?

A: Two good but very different documents ...
And to succeed each must establish buy-in from the ***Public*** and the ***Research Community***

Can Two Become One?

- "To land a man on the Moon"
  - Was a high-level objective
  - Did not specify specific Scientific and Technological implementation
- Is there really room for two independent Grand Challenges in the Microelectronic space? ... I think not!
  - '... Microelectronic Design' is closer to a classic Grand Challenge
  - '... Silicon Technology' is more like an 'elaboration program' such as would occur within the scope of a higher-level Grand Challenge
- I propose that they are combined under four GCs ...
  - Batteries not included
  - Moore for less
  - Silicon meets life
  - Building brains

... With two elaborations programmes (more to follow)
... Halving the task of 'Selling' it to the Public

Business Involvement in Grand Challenges

Because..

- There is not a 1:1 between Existing Business and the GCs themselves.

..And..

- The Science that will emerge during a GC is unpredictable

..Then..

- Business ***can only have*** Altruistic involvement in Grand Challenges

However..

- Because Business can value the benefits of Technology applied to its near term business activities

..Then..

- Businesses **can be** Proactively involved with Technology Challenges

Aiming Ahead of the Duck

- So Businesses are poor at visualising their need 2+ yrs
  - Typically their vision is ***much less*** than this!
  - Individuals may have longer vision, but without Business support
- So Businesses use Internal Targeted Research for 0-2 yr horizon.
  - Acquisition Strategy for things that will take longer to establish
    - *Buy or Licence; Individuals, Groups, Companies, Tools, Methods*
    - *Wherever in the world they occur (Thanks to Globalisation)*
- Partner with Business to get your ***specific Technology*** adopted
  - It has to apply to a Problem that they can foresee in <2yrs
  - It has to be within 2yrs of them establishing it as a Capability
  - It has to be ***Packaged*** & ***Marketed Globally ... As potential Capability***
- Get general support from Business for your ***Science*** objectives
  - Get Business involved it its wider goals/objectives
  - Don't expect specific guidance, finance or resource
  - Keep illustrating/visualising the Technology it could become
  - It also has to be ***Packaged*** & ***Marketed Globally ... As potential Technology***

Conclusions

- Academic Research and Business are parts of a economic continuum
  - They both need to understand their places and contribution
- Business is there to make money ...
  - Poor at predicting its issues more than ~2yr out
  - Is guided by its Investors and constrained by its Capabilities
  - Needs Technology as part of achieving business (Not Science)
  - Is operating in a global supply/demand market
- Academic Research leans toward establishment of Science
  - Needs long-term guidance from ***Agreed*** Grand Challenges
    - *Needs Public and Researcher buy-in for this (Less-so Business)*
  - Converts best Science into Technology for 'sale' to Businesses
  - Is also operating in a global supply/demand market

Reading & References

- "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail"
  - by Clayton M. Christensen
- "Open Innovation: The New Imperative for Creating and Profiting from Technology"
  - by Henry William Chesbrough
- "The World Is Flat"
  - by Thomas L. Friedman
- "Firm resources and sustained competitive advantage"
  - Jay Barney : 1991

- Ian Phillips Blog
  - http://ian-phillips.blogspot.com/